***Instructions to Compile and Run***

1. The code is present in NaiveBayes&KNN folder.
2. You have to execute ProgammingAssignment.py file
3. The instructions printed on the python file are intuitive to select the options for various questions
4. The requirements for the execution are Numpy, SciKit Learn(sklearn) and the rest all libraries are available along with python
5. Make Sure you have all the three files KNearestNeighbours.py, NaiveBayes.py, PCA.py in the same folder while execution.

**SAMPLE OUTPUT**

runfile('C:/Users/Yonarp/OneDrive/Codes/NaiveBayes&KNN/ProgammingAssignment.py', wdir='C:/Users/Yonarp/OneDrive/Codes/NaiveBayes&KNN')

You have 4 choices over four questions, select 1,2,3,4

Enter a number :: 1

You have selected an option to visualize the i/p data and convert the data to vectors

Displaying one Image for each number trainingDigits

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Converting all the data to Vector started

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Converting all the data to Vector DONE

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Do you want to continue, type 1 for yes, 0 otherwise :: 1

Enter a number :: 2

You have selected an option for Naive Bayes classifier

Calculating the Likelihood and Prior

The training error rate is :: 18.36 %

The testing error rate is :: 18.39 %

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Do you want to continue, type 1 for yes, 0 otherwise :: 3

Enter a number :: 3

You have selected an option for KNN classifier

Please NOTE it will takes 15 minutes for KNN to run

Evaluating the testing error in KNN using different k values

The testing error rate for k = 1 is : 1.3742071881606766

The testing error rate for k = 2 is : 2.3255813953488373

The testing error rate for k = 3 is : 1.1627906976744187

The testing error rate for k = 4 is : 2.00845665961945

The testing error rate for k = 5 is : 1.9027484143763214

The testing error rate for k = 6 is : 2.431289640591966

The testing error rate for k = 7 is : 2.536997885835095

The testing error rate for k = 8 is : 2.536997885835095

The testing error rate for k = 9 is : 2.431289640591966

The testing error rate for k = 10 is : 2.2198731501057085

Evaluating the training error in KNN using different k values

The training error rate for k = 1 is : 0.0

The training error rate for k = 2 is : 2.637021716649431

The training error rate for k = 3 is : 1.4477766287487073

The training error rate for k = 4 is : 2.1716649431230612

The training error rate for k = 5 is : 1.7063081695966906

The training error rate for k = 6 is : 2.2750775594622543

The training error rate for k = 7 is : 2.1716649431230612

The training error rate for k = 8 is : 2.688728024819028

The training error rate for k = 9 is : 2.481902792140641

The training error rate for k = 10 is : 2.5853154084798344

Evaluating the testing error in KNN using Model Averaging

The testing error for Model Averaging is : 1.7970401691331923

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Do you want to continue, type 1 for yes, 0 otherwise :: 1

Enter a number :: 4

You have selected an option to utilize PCA

Naive Byes after PCA to reduced data dimension to 512

Calculating the Likelihood and Prior

C:\Users\Yonarp\OneDrive\Codes\NaiveBayes&KNN\NaiveBayes.py:122: RuntimeWarning: invalid value encountered in log

o\_put = np.log(np.dot(likelihood,vf(image.inp\_data.T)))+np.log(prior)

The training error rate is :: 22.75 %

C:\Users\Yonarp\OneDrive\Codes\NaiveBayes&KNN\NaiveBayes.py:136: RuntimeWarning: invalid value encountered in log

o\_put = np.log(np.dot(likelihood,vf(image.inp\_data.T)))+np.log(prior)

The testing error rate is :: 71.25 %

KNN after PCA to reduced data dimension to 512

Please NOTE it will takes 15 minutes for KNN to run

Evaluating the testing error in KNN using different k values

The testing error rate for k = 1 is : 1.3742071881606766

The testing error rate for k = 2 is : 2.3255813953488373

The testing error rate for k = 3 is : 1.1627906976744187

The testing error rate for k = 4 is : 2.00845665961945

The testing error rate for k = 5 is : 1.9027484143763214

The testing error rate for k = 6 is : 2.431289640591966

The testing error rate for k = 7 is : 2.536997885835095

The testing error rate for k = 8 is : 2.536997885835095

The testing error rate for k = 9 is : 2.431289640591966

The testing error rate for k = 10 is : 2.2198731501057085

Evaluating the training error in KNN using different k values

The training error rate for k = 1 is : 0.0

The training error rate for k = 2 is : 2.637021716649431

The training error rate for k = 3 is : 1.4477766287487073

The training error rate for k = 4 is : 2.1716649431230612

The training error rate for k = 5 is : 1.7063081695966906

The training error rate for k = 6 is : 2.2750775594622543

The training error rate for k = 7 is : 2.1716649431230612

The training error rate for k = 8 is : 2.688728024819028

The training error rate for k = 9 is : 2.481902792140641

The training error rate for k = 10 is : 2.5853154084798344

Do you want to continue, type 1 for yes, 0 otherwise :: 0